

adult (both females), of the same species. One, received from Mr. Carl Hagenbeck, of Hamburg, on the 25th of March 1881, died on the 4th of the following month; the other, received from Mr. W. Cross, of Liverpool, on the 15th of July 1880, lived until the 31st of March 1881. Both these examples are from South America. One of them is rather darker, and the pubescence on the cephalothorax is of a more coppery reddish hue; but in other respects it agrees with the example described, though neither of them is quite so large.

#### EXPLANATION OF PLATE LX.

- Fig. 1. ♀ *Homœomma stradlingi* (from Dr. Stradling's specimen). Natural size.  
 2. The same. Profile of cephalothorax and falces, a little enlarged.  
 3. The same. Eyes from above and behind.  
 4. The same. Eyes from in front, looked at on a level with the Spider.  
 5. The same. ♂ from Brazil, right palpus, of natural size.  
 6. The same. Portion of right palpus enlarged, from above and behind, on the outer side.  
 7. The same. Portion of right palpus, from underneath.

#### 4. On the Structure of the Pharynx, Larynx, and Hyoid Bones in the *Epomophori*; with Remarks on its Relation to the Habits of these Animals. By G. E. DOBSON, M.A., M.B., &c.

[Received May 17, 1881.]

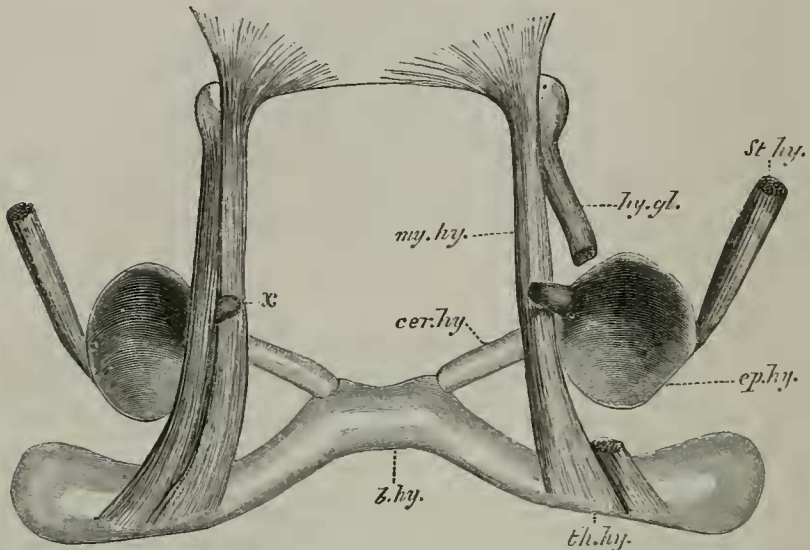
In all species of Chiroptera, of which the structure of the pharynx and larynx has hitherto been described, and in all those examined up to the present by the writer, the form of these parts has been found remarkably simple, differing but slightly from that of the Insectivora, all agreeing in possessing a short pharynx, with the small circular or narrow slit-like aperture of the larynx generally guarded by a short acutely-pointed epiglottis, which, in some genera (*Harpyia*, *Vampyrus*, e. g.), is almost obsolete, opening close behind the fauces, near to which also the posterior nares enter—and in the small size of the laryngeal cavity and feeble development of the vocal cords, the hyoid bone also being slender and connected by a chain of simple cylindrical bones with the cranium.

In the *Epomophori*, however, we find in the structure of all these parts a remarkable departure from the general type: the pharynx is long and very capacious, the aperture of the larynx far removed from the fauces; and opposite to it a canal leading from the uarial chambers and extending along the back of the pharynx opens; the laryngeal cavity is spacious, and its walls are ossified; and the vocal cords are well developed; the hyoid bone is quite unconnected, except by muscle, with the cranium; the ceratohyals and epihyals are cartilaginous and greatly expanded, entering into the formation of the walls of the pharynx, and, in the males of two species at least,

supporting the orifices of the large posterior pair of air-sacs which extend beneath the integument of the sides of the neck<sup>1</sup>.

This peculiar development of the pharynx, larynx, and hyoid bones is well seen in *Epomophorus franqueti*. In that species the spacious cavity of the mouth opens into the wide and deep pharynx by a very restricted aperture, the inferior transverse diameter of which is not half the width of the tongue, and scarcely capable of

Fig. 1.



Hyoid bones and muscles of *Epomophorus franqueti* (enlarged).

*b.hy.* Basihyal bone with which the long thyrohyals, *th.hy.* are ankylosed (the latter are shown diagrammatically, as in nature they are hooked round the thyroid cartilage); *cer.hy.* ceratohyal bone; *ep.hy.* epihyal bone rotated forwards, showing its outer surface deeply concave for the neck of the posterior pharyngeal sac, and its prominent articular extremity (*x*) separating and acting as a pulley for the fleshy tendons (*my.hy.*) of the mylo-hyoid and (*hy.gl.*) hyo-glossus muscles; to its upper margin is attached the tendon (*st.hy.*) of the stylo-hyoid muscle.

admitting a hemp-seed, and which can evidently be completely closed by muscular action. In two male specimens the tip of the epiglottis is nearly three quarters of an inch from the fauces. The laryngeal walls are ossified, forming a large projection in the posterior

<sup>1</sup> The writer was unable to embody any part of these remarks in the introduction to his work on the Chiroptera (Catal. Chiropt. Brit. Mus. 1878) owing to the want of specimens available for anatomical examination. Later, however, chiefly owing to the kindness of Drs. T. W. Wright and J. J. Lamprey, of the Army Medical Department, and Dr. Robb, of H.M.'s Indian Army, who forwarded well-preserved specimens of *Epomophori* from the west and east coasts of Africa, he has succeeded in obtaining most of the material which forms the basis of this paper.

third of the neck; and the wide space intervening between the epiglottis and the base of the tongue is seen, on removal of the integument, to be covered in by the mucous membrane of the pharynx only. The mylo-hyoid muscle arises on each side from the thyrohyoid bone between the insertion of the sterno-hyoid muscle and the origin of the middle constrictor of the pharynx, and, suddenly narrowing, forms a half-round fleshy tendon, which passes forwards across the projecting articular extremity of the epihyal bone (fig. 1, *x*), which acts as a pulley, and on reaching the under

Fig. 2.

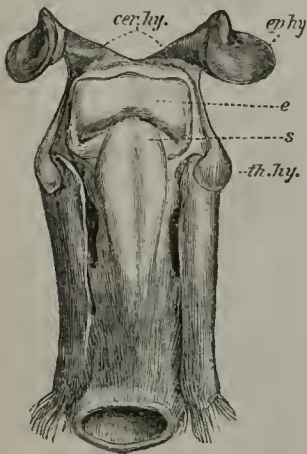


Fig. 3.

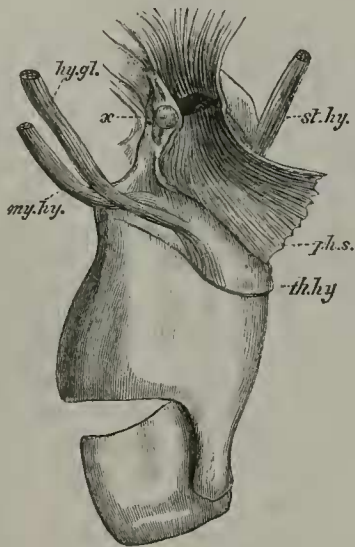


Fig. 2. Hyoid bones and larynx of *Epomophorus franqueti* (enlarged), viewed from above. *ep.hy.*, epihyal bone; *cer.hy.*, ceratohyal bones; *th.hy.*, extremity of thyrohyal bone; *e*, epiglottis, posterior surface; *s*, Santorinian cartilages.

Fig. 3. Side view of part of the hyoid bones and the larynx of *Epomophorus franqueti* (enlarged), showing (*ph. s*) part of the neck of the posterior pharyngeal sac and its communication with the pharynx; *x*, the prominent articular extremity of the epihyal bone; *st.hy.*, stylo-hyoid muscle; *my.hy.*, mylo-hyoid, and *hy.gl.*, hyo-glossus muscles, divided and drawn backwards; *th.hy.*, thyrohyal bone.

surface of the tongue spreads out, uniting with its fellow of the opposite side to form a thin muscular expansion extending between the rami of the mandible almost as far forwards as the symphysis menti. Immediately external to the origin of the mylo-hyoid the hyo-glossus arises by a much narrower origin, and, forming a perfectly similar tendon, accompanies it forwards, but separated from it by the projecting articular extremity of the epihyal bone, and, curving inwards above it, is inserted into the side of the tongue. The genio-hyoid and genio-hyo-glossus muscles are absent, the basi-

hyal and ceratohyal bones being connected with the base of the tongue by the membranous walls of the pharynx alone.

The hyoid bone (figs. 1, 2, 3) is remarkably formed: the basi-hyal is ankylosed behind to a pair of long spatulate thyrohyals; in front it articulates on either side by a synovial joint, permitting very free rotatory motion, with a cartilaginous ceratohyal, which also articulates by its upper extremity with a large, very peculiarly shaped cartilaginous epihyal, which is circular in outline, having its inner side flat or slightly convex, its outer deeply concave from below backwards and upwards, and near its articular extremity a prominent external projection, across which the tendons of the mylo-hyoid and hyo-glossus muscles, above described, glide; the ceratohyal muscle extends from its posterior margin to the thyrohyal bone; and the stylo-hyoid muscle is inserted into its upper side. Its outer surface, as above described, is deeply concave in the adult male, and is lined by part of the neck of a sac, which extends outwards and backwards from the pharynx, under cover of the integument and the sterno-mastoid muscle, across the clavicle to the antero-inferior part of the thorax. Another sac, anterior to this, on each side of the neck, also extends outwards from the pharynx, and will be described further on (*vide infra*, fig. 4).

The walls of the evidently highly extensible pharynx are attached anteriorly to the base of the skull and to the back of the fauces and tongue (which is free between the hyo-glossi and stylo-glossi muscles; for there is no trace of genio-hyoid or genio-hyo-glossi muscles, and the body of the organ appears to be chiefly made up of a few muscular fibres with much interposed fat), extending forwards for some distance between its inferior surface and the mylo-hyoid expansion—posteriorly, to the anterior margins of the basi-, cerato-, and epihyal bones, and laterally, by an oblique ligamentous band, to the sterno-mastoid muscles. Immediately behind the mouth, in the adult male, are two large oval apertures (0·4 inch in antero-posterior diameter) in the sides of the pharynx, leading into a pair of large sacs, which extend outwards under cover of the integument beneath and behind the ears. The apertures open opposite each other; so that, if the sacs be cut open from without, the pharynx appears to be transfixed. These, which may be called the anterior pharyngeal sacs, are separated on each side of the neck from the posterior pharyngeal sacs (above described) by the sterno-mastoid muscle, and by a ligamentous septum passing inwards from it to the side of the pharynx, and outwards to the integument. Both pairs of sacs are absent in the female; their presence therefore indicates a secondary sexual character, of which the nearest analogue in Mammals appears to be the laryngeal sac of the Orang<sup>1</sup>.

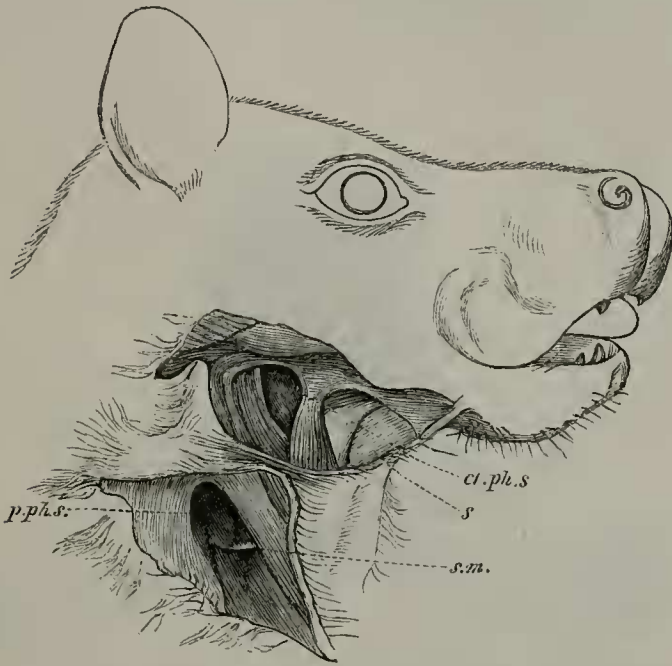
<sup>1</sup> It is an interesting fact that the nearest known analogues of these pharyngeal sacs are to be found not among Mammals but in Birds, as in certain species of *Otis* and *Tetrao*. This might lead us to think that this peculiar secondary sexual character was in some way related to the volant powers of the animals. It must, however, be recollected that these birds are noted for their terrestrial habits.



The nasal cavities are brought into communication with the larynx by a long canal, which extends backwards along the spine and enters the pharynx directly opposite to the aperture of the larynx; so that the greater part of what we have called the pharynx would be evidently more correctly termed the isthmus faucium.

The walls of the larynx are ossified, enclosing a spacious cavity,

Fig. 4.



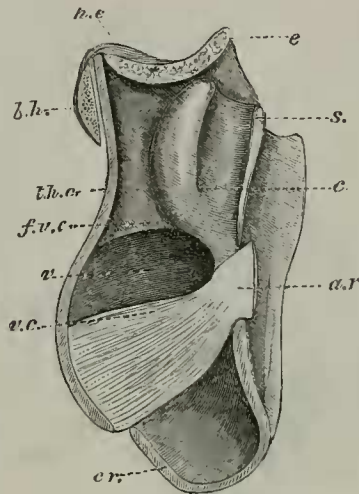
Head and neck of *Epomophorus franqueti* (ad. ♂, natural size).

The anterior (*a.ph.s.*) and posterior (*p.ph.s.*) pharyngeal sacs are opened from without, the dotted lines indicating the points where they communicate with the pharynx; *s*, thin membranous septum in middle line between the anterior pharyngeal sacs of opposite sides; *s.m.*, sternomastoid muscle separating the anterior from the posterior sac.

the anterior aperture of which (figs. 2 & 5) is protected by a very large epiglottis (*e*), which rests against the rounded anterior extremities of a pair of large crescent-shaped fibro-cartilaginous cushions (*c*), which extend forwards from the anterior margins of the triangular arytenoid cartilages (*a*). The true vocal cords are well developed and much longer than the false cords; the ventricles are spacious, and continued backwards between the true vocal cords and the thyroid, forming large sacculi, and forwards between the false vocal cords and the thyroid to its anterior margin, forming narrower but much longer "*sacculi laryngis*."

In *E. comptus* the structure of all the above-described parts is similar—with this exception only, that the tendons of the mylo-hyoid and hyo-glossus muscles pass forwards together below the epihyal process. No male specimens of *E. pusillus* are available for examination; but, judging from the anatomy of the female, it agrees in all respects with that of *E. comptus*. In *E. monstrosus*, which differs from all the other species in the absence of the shoulder-pouches, there are no posterior air-sacs; but the anterior sacs are well developed, and separated internally below, not by a thin parti-

Fig. 5.



Vertical and longitudinal section through the centre of the larynx of  
*Epomophorus franqueti* (enlarged).

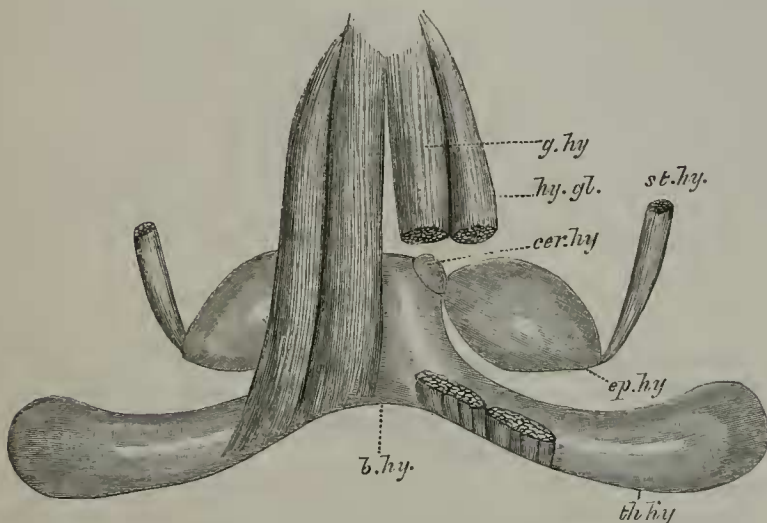
*e*, epiglottis; *h.e.*, hyo-epiglottideus muscle; *b.h.*, basihyal bone; *th.c.*, thyroid cartilage; *f.v.c.*, false vocal cord; *v.*, ventricle leading *anteriorly* into the long sacculus laryngis, extending almost as far as the base of the epiglottis, and *posteriorly* continued backwards behind *v.c.*, the true vocal cord; *ar.*, arytenoid cartilage; *s.*, apex of Santorinian cartilage; *c.*, crescentic fibro-cartilaginous cushion extending forwards from the arytenoid cartilage; *cr.*, cricoid cartilage.

tion as in the above-named species, but by an intermediate inferior sac communicating with the pharynx by an aperture between the mylo-hyoid tendons.

In *E. macrocephalus*, *gambianus*, *labiatus*, and *minor* the thyrohyals are very long, having their broad extremities bent inwards above so as to nearly meet in the middle line above the laryngeal opening; the basihyal (fig. 6, *b.hy*) is much produced forwards, terminating in a straight thin edge, to the outer sides of which the very short ceratohyals are attached by ligament only, and have a

very restricted backwards-and-forwards motion; the epihyals are lozenge-shaped, expanded, as in *E. franqueti*, but quite flat, and give attachment to the same muscles as in that species; but their infero-external extremities are not produced into prominent cornua as in that species; for there are no mylo-hyoids to support, the place of these muscles being taken by the united anterior bellies of the digastrics, which extend across as a thick muscular fold from side to side, and so far back as to cover the body of the hyoid bone, to which, however, it is not attached, being connected only with the superficial fascia extending backwards over the sterno-hyoid muscles.

Fig. 6.



Hyoid bones and muscles of *Epomophorus macrocephalus* (enlarged).

*b.hy.*, basihyal bone; *th.hy.*, thyrohyal bone; *cer.hy.*, ceratohyal bone, small, almost ankylosed with the prominent anterior margin of the basihyal; *ep.hy.*, epihyal bone, dislocated forwards, showing its flat, or very slightly concave, outer surface; *st.hy.*, stylo-hyoid muscle; *g.hy.* and *hy.gl.*, genio-hyoid and hyo-glossus muscles passing forwards over the prominent anterior margins of the basihyal and ceratohyal bones.

On dividing and reflecting the digastrics the genio-hyoid muscles at once come into view, arising from the body of the hyoid bone posteriorly, and passing forwards over the prominent flat edge of its produced anterior part, as over a pulley, being there also supported on a pad of dense ligamentous tissue which occupies part of the space in front of the epiglottis, arising from the inner sides of the box-like compartment formed by the expanded hyoid bones, and extending also laterally outwards as a thick ligamentous band on each side across the articulation of the epihyal with the ceratohyal bone, and between the former and the fleshy tendon of the hyo-

glossus muscle. The small genio-hyo-glossi arise on each side from the anterior margins of the epihyals.

From the pharynx, thus closed in by osseous and muscular walls, no sacs extend outwards as in *E. franqueti*; but near the commencement of the œsophagus, opposite the opening of the larynx, there is the aperture of a single central sacculus, which lies between the middle constrictor of the pharynx and the spine, its neck passing between the fibres of that muscle, which forms a lozenge-shaped sphincter round it. It is difficult to suggest the office of this sac, the cavity of which in *E. macrocephalus* is not larger than a small bean, and in *E. minor* would hardly hold a pea.

Owing to the presence of the large inflected extremities of the thyrohyals, which nearly meet in the middle line across the commencement of the œsophagus, the inferior constrictors of the pharynx are much shorter, and do not form a pair of long fleshy tendons carried forwards longitudinally between the extremities of the epihyals as in *E. franqueti*; while the middle constrictors are distinguishable from them, and part of their fibres form a sphincter for the neck of the sacculus above described.

The remarkable form of the hyoid bones and great development of the isthmus faucium part of the pharynx, in which (though especially pronounced in the males of certain species) all the species agree, may be understood when we consider the nature of the food of these animals.

In the collection of the British Museum are specimens of *E. gambianus* from the banks of the Zambesi, with the note "eating figs" on the label attached to them by the donor Dr. Kirk. That figs constitute the food of *E. franqueti*, *macrocephalus*, *labiatus*, and *minor* also I have proved by finding remains of these fruits in the alimentary canals of these species.

The fig being a hollow receptacle containing numerous small fruits, is not easily detached from the branch for the purpose of mastication; and its outer rind is evidently too tough to be readily torn through by the feeble teeth of the *Epomophori*. The easiest method, therefore, of getting at its soft juicy contents is by sucking them out through the aperture at the distal extremity of the fig.

Now the whole structure of the mouth and pharynx of these animals is admirably suited for this purpose. The peculiarly voluminous lips are capable of completely encircling the fig, and their adherence to its smooth surface is evidently securely maintained by the soft pads which spring from their upper margins near the angles of the mouth. While thus encircled by the lips, the fruit is probably slowly chewed by the feeble acutely pointed teeth, and pressed upwards against the prominent palate-ridges so as to cause it to give up more freely its juices and soft contents, which are drawn out by suction through the terminal aperture.

The construction of the parts above described is specially suited to the action of suction, accomplished probably by the alternate action of the buccal muscles and the lungs. The spacious pharynx, shut off from the nasal apertures by the constrictors of the pharynx,



and from the mouth by the small valvular opening referred to, and having its sides supported behind by the expanded hyoid bones, constitutes a most perfect exhauster; while the broad epiglottis, permanently folded over the larynx in front so that its aperture is directed upwards towards the spine, and the great size of the fibro-cartilaginous masses extending forwards from the arytenoid cartilages to the epiglottis (fig. 5, c, p. 690), effectually guard the glottis, preventing any part of the food, such as the small fig-seeds, from being drawn into the air-passages.

In the males of *E. monstrosus*, *franqueti*, *comptus*, and *pusillus*, permanent inflation of the pharyngeal sacs is rendered possible by the manner in which, as above described, the nasal and oral cavities are capable of being completely shut off from the pharynx. Considering the large size and position of the apertures by which these sacs communicate with the pharynx, it would appear at first sight that most of the food entering the pharynx must find its way into them. This difficulty is removed if we allow that suction by means of the inspiratory action of the lungs has any thing to do with drawing the semifluid food into the pharynx; for it is evident that the same action would cause the walls of the sacs to collapse inwards upon the apertures, and so close their communication with the pharynx at the very time when it was most needed.

5. On the Mollusca procured during the 'Lightning' and 'Porcupine' Expeditions, 1868-70. (Part III.<sup>1</sup>) By J. GWYN JEFFREYS, LL.D., F.R.S., F.Z.S.

[Received May 20, 1881.]

(Plate LXI.)

## CONCHIFERA (*continued*).

### Family VIII. KELLIIDÆ.

#### 1. PYTHINA SETOSA, Dunker.

✓ *Coralliophaga setosa* (Dunker), Grube, Die Insel Lussin und ihre Meeresfauna, 1864, p. 48.

*Scintilla recondita*, Fischer, Les Fonds de la Mer, 1872, p. 49, pl. ii. f. 3.

'Porcupine' Exp. 1870: Atl. St. Tangier Bay; Med. 50, 50a.

*Distribution.* Arcachon to Mogador, Sicily, and Adriatic. Depths 5 to 86 fathoms.

*Fossil.* Pliocene: Monte Mario and Ficarazzi.

*Sportella caillati*, Conti, and *Kellia macandrewi*, Fischer. It belongs to *Pythina* in respect of the hinge as well as of the peculiar divaricating sculpture.

<sup>1</sup> For Part I. see P. Z. S. 1878, p. 393; for Part II. see P. Z. S. 1879, p. 553.